SIEMENS

MOBILETT XP (Hybrid / Eco)

SP

Maintenance Instructions

System

including DHHS requirements

The protocol SPR8-230.832.01.06.02 is required for these instructions

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English

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1 General information

1.1 Performing the work



Any technician duly assigned by the local Siemens office is authorized to perform maintenance and service work.

Certain tasks may also be performed by other technical personnel (e.g. the customer's hospital technicians). These tasks are labeled with the icon shown here.

In such cases it is absolutely necessary:

- to observe all instructions in the text and graphics;
- to use the specified tools, test equipment and aids.

You can also contact your national Siemens Uptime Service Center for support.

1.2 Special notes

⚠ DANGER

DANGER indicates an immediate danger that if disregarded will cause death or serious physical injury.

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∆WARNING

WARNING indicates a possible danger that if disregarded can cause death or serious physical injury.

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⚠CAUTION

CAUTION used with the safety alert symbol indicates a possible danger that if disregarded will or can lead to minor or moderate physical injury and/or damage to property.

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NOTICE

NOTICE used without the safety alert symbol indicates a possible danger that if disregarded may or will lead to an undesirable result or state other than death, physical injury or property damage.

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NOTE

NOTE is used to indicate information that explains the proper way to use devices or to carry out a process, i.e., provides pointers and tips.

1.3 Icons



Warning about ionizing radiation or radioactive substances. Tests and adjustments that must be performed with the radiation switched on are indicated by this radiation warning icon.



Dangerous electrical voltage > 25 VAC or > 60 VDC.



Caution! General hazard warning.



ESD: Warning about electrostatically sensitive components.



Report icon. Used to indicate entries in certificates.



Certain tasks can also be performed by other technical personnel (e.g. the customer's hospital technicians).

U S

Certain sections apply only to the USA. These sections are marked with this icon.

Fig. 1:

1.4 Information on product safety and protective measures



Lethal electric shock and radioactive contamination hazards exist.

- While troubleshooting or servicing, individuals can come into contact with dangerous components.
- Some tests and adjustments must be performed with the radiation turned on.

Disregarding the safety instructions will lead to death or serious bodily injury.

- ⇔ When performing service and tests always observe:
- the product-specific safety information contained in the technical documentation,
- → and the general safety information (TD00-000.860.01...).

 \Box

- Remove or install components only if:
- ¬ the system is switched off, and

 ¬ the syste
- the capacitors are discharged, and
- → for the XP Hybrid, the batteries are disconnected.

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 □ Tests and adjustments that must be performed with the radiation switched on are marked by this radiation warn- ing icon. The required radiation protection measures must be followed for these adjustments.

⚠ DANGER

Lethal shock hazard exists.

Anyone performing troubleshooting and/or service with the safety covers off may come into contact with live parts. This hazard exists as long as:

- the power supply is connected;
- the capacitor bank or individual capacitors are still charged; capacitors may still be charged even when the system is switched off and the power cord is disconnected (e.g. due to defective fuses)!
- the battery blocks in the XP Hybrid are connected!

Disregarding the safety instructions will lead to death or serious bodily injury.

- □ Do not touch potentially dangerous components(Fig. 2 / p. 10)
- If loose parts must be removed from the unit, use only insulated tools;
- □ Protect the work area so that no other persons are able touch the unit while the covers are open or removed!
- Switch the unit off before servicing or maintenance. Always disconnect the power plug first.
- XP Hybrid: Make sure that the main switch and the battery mode are switched off.
- The capacitor bank discharges to < 40 V in approx. 15 minutes.
- The safety covers can be removed after this period has elapsed. The locations with dangerous voltage still require extreme caution (see (Fig. 2 / p. 10)).

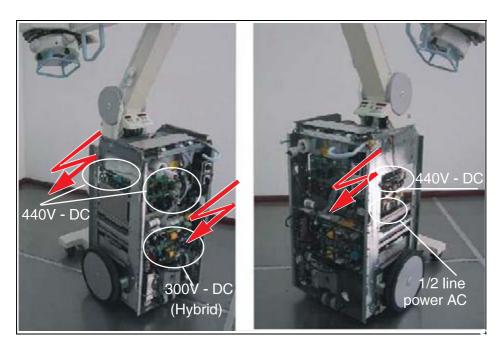




Fig. 2: Locations with dangerous voltage
With housing covers open and safety covers removed.

Back:

dangerous DC voltage (440V) on capacitor bank (D927)

Left:

Dangerous DC voltage (440V) directly on capacitor bank!

Right:

Dangerous DC voltage (440V) directly on capacitor bank!

Dangerous AC voltage (> 100V or > 60V half line voltage) on power supplies U1 and U2 as long as the power cord is connected.

Additionally for XP Hybrid:

Dangerous DC voltage (300 V) from the battery block to PCB D982! Always disconnect the battery plug from BK1-BK4.

1.5 System overview - user

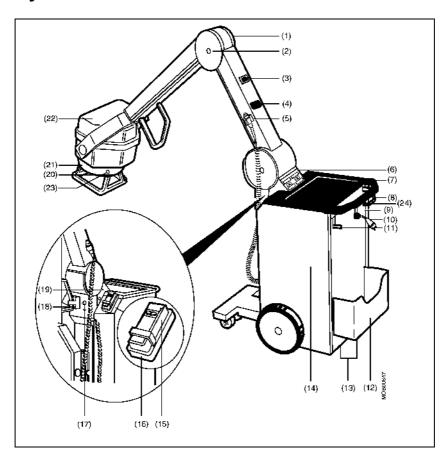


Fig. 3: User overview_01

(1) Hanger for lead apron	(13) Castors
(2) Articulated arm	(14) Console with chassis
(3) Sensor for IR remote control (optional)	(15) IR remote control (optional)
(4) DAP display (optional)	(16) Holder for IR remote control (optional)
(5) Exposure switch (S27)	(17) Potential equalization connector
(6) Control panel and display field	(18) Transport safety device
(7) Transport handle	(19) Stand column
(8) Hand/parking brake handle	(20) Multileaf collimator
(9) Main switch	(21) DAP ionization chamber (optional)
(10) Power cord	(22) X-ray tube assembly
(11) Brake handle for cable winch	(23) Light localizer buttons (two sides)
(12) Cassette compartment	(24) Motor control (Hybrid)

1.6 Orientation

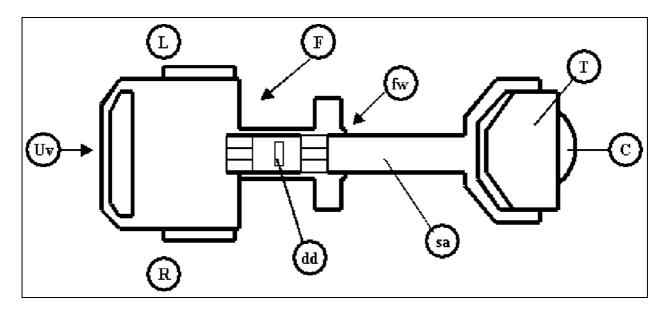


Fig. 4: Top view of system_01

System orientation to clarify the technical description		
Abbreviations	Explanation	
Uv	User view - back (U ser v iew)	
L	Left side of unit (left)	
R	Right side of unit (right)	
F	Front (front)	
fw	Front wheels (front wheels)	
sa	Support arm (support arm)	
Т	Tube (single tank)	
С	Multileaf collimator (collimator)	
dd	DAP display (dose display)	

NOTE

These orientation indicators are used in all technical documents. Descriptions are always from the "forward travel" user view. Always use this perspective when communicating with third parties (e.g., USC/HSC).

1.7 System overview - Service

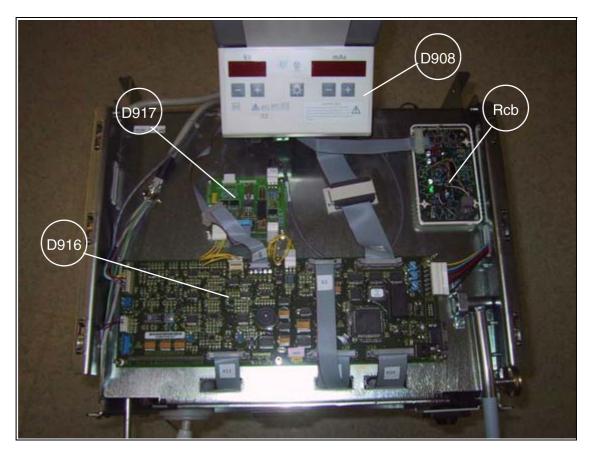


Fig. 5: Top view_01

Common parts of MOBILETT XP, Eco and Hybrid		
Abbreviations	Explanation	
D908	User display and control	
D916	CPU board	
D917	Galvanic separation for S27/DAP/remote	
Rcb	Remote control board (remote control option)	

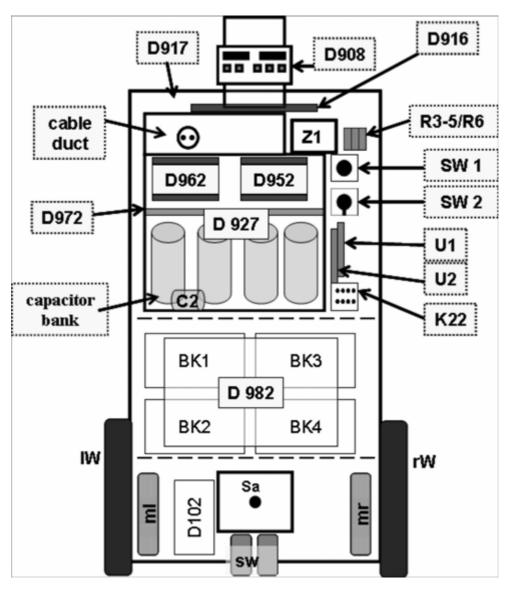


Fig. 6: Schematic overview of XP, Eco, Hybrid

Common parts of MOBILETT XP, Eco and Hybrid		
Abbreviations	Explanation	
SW1	Key switch, power ON/OFF	
Z1	Line filter	
C1 (R1)	Capacitor for inverter with discharge resistor (front left side/not shown here)	
C2 (R2)	Starter capacitor with discharge resistor	
R3 - 5 / R6	R3-R5 internal discharge resistor for capacitor bank	
(Front right)	R6 separate discharge resistor for Service	
Capacitor block	12 x 10 mF capacitors, mounted with D972	
K22	Main relay	

+5V/± 15V power supply		
+24V power supply		
Voltage supply		
Capacitor bank charging board (behind D927)		
kV inverter (behind D927)		
Capacitor bank board (behind D927)		
Support arm adjusting spring		
Castors		
Additional components for MOBILETT XP Hybrid only		
Op. mode selector (battery/off/power)		
Battery charger		
Motor drive control		
Battery block, left		
Battery block, right		
Motor right/motor left		
Optional parts for MOBILETT XP; Eco and XP Hybrid (not shown)		
Dose area product measuring chamber (mounted on the collimator)		
DAP adapter board (mounted in the collimator cover)		
DAP display board (mounted in the lower arm segment cover)		

1.8 Cleaning

- Always disconnect the MOBILETT from the power supply and switch it off before cleaning or disinfecting it.
- Never use abrasive cleaners or cleaning agents with solvents (e.g. cleaning solutions, alcohol or spot removers), since they may damage housing surfaces.
- Do not spray anything on or into the unit.
- Wipe off the MOBILETT with a cloth moistened in water or a diluted, lukewarm solution of water and dishwashing liquid.

For more information, see the section on "Cleaning and disinfection" in the operating instructions.

2 General maintenance information

2.1 Required Documents

•	General safety information	TD00-000.860.01
•	Startup Instructions	SPR8-230.814.01
•	Troubleshooting Instructions	SPR8-230.840.01
•	Instructions on Replacement of Parts	SPR8-230.841.01
•	Wiring Diagram MOBILETT XP (Eco)	SPR8-230.844.01
•	Wiring Diagram MOBILETT XP Hybrid:	SPR8-230.844.05
•	Operator Manual	SPR8-230.621.01
•	Technical Safety Checks - Protocol*	SP00-000.834.01

^{*} Within the purview of DIN VDE 0751-1, we recommend documenting the results of the maintenance both in the maintenance protocol and in the TSC protocol. The protocols should be filled out completely and handed over to the client after maintenance is complete.

2.2 Required Tools, Test Equipment and Aids

- Standard servicing tools
- Digital multimeter
- kV measurement device (with filter comparison method) or 2-channel storage oscilloscope with
 - \pm 2.5 % accuracy
- mAs meter or 2-channel storage oscilloscope with ± 2.5% accuracy
- 2-channel storage oscilloscope with ± 2.5% accuracy
- Protective conductor meter
- Device leakage current measuring device
- Spring balance for 350 N
- Torque wrench for 6-12 Nm and 20-25 Nm
- Rope (minimum length 4m; minimum tensile strength 1000 N)
- Loctite 242
- Viscogen oil
- 2 pieces of wood, approx. 50 x 75 x 500 mm

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- Dose measuring device (USA only)
- Lux meter (USA only)

2.3 Maintenance schedule

Required procedures	Interval	
Mechanical test (in accordance with these instructions)	12 months	
Functional test (in accordance with these instructions)	12 months	
Replacement of parts ("Material interval" table)	n.a.	
Check kV/mAs accuracy	12 months	
USA only:		
Reproducibility test	12 months	

2.4 Material replacement

Material	Material No.	Interval
Collimator light	08392016	12 months
XP (Eco) only		
Cable winch complete	06508746	24 months
Hybrid only		
Battery pack (left) BK1/BK2	08392024	24 months
Battery pack (right) BK3/BK4	08392032	24 months
Cable winch complete	06508746	48 months
Option		
Remote control batteries	1x9V alkaline	12 months

Replace damaged or missing screws.

NOTE

Replace damaged or missing screws only with steel screws. All Allen screws must have a tensile strength of 8.8.

Materials needed for periodic replacement can be requested from the responsible local Uptime Service Center.

2.5 Protocol

The maintenance protocol must be completed and signed. Replacement and repair measures must be listed separately in the protocol under "Work procedures performed".

2.6 Information for the USA only

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To ensure compliance with the applicable regulations in the "US Federal Performance Standard", the system user is responsible for performing maintenance procedures at least once each year.

Neither the system manufacturer nor its representatives assume any responsibility in the event of non-compliance with the above requirements.

2.7 Explanation of the test items

Test item	Description
abbreviation	
SI	Safety Inspection
SIE	Electrical safety inspection
SIM	Mechanical safety inspection
PM	Preventive maintenance
PMP	Periodic preventive maintenance
РМА	Preventive maintenance adjustments
PMF	Preventive maintenance maintenance function, check operating values
Q	Quality check
QIQ	Image quality test
QSQ	System quality test
SW	Software maintenance

The maintenance protocol lists these abbreviations for the test items.

2.8 Information on the protective conductor resistance test

Observe the instructions in the "Safety Rules for Installation and Repair" (ARTD-002.731.17 ...).

The protective conductor resistance must be measured, documented, and evaluated during maintenance.

NOTE

For evaluation purposes, the first measured value and the values documented during maintenance or safety checks must be compared to the measured values. A sudden or unexpected increase in the measured values may indicate a defect in the protective conductor connections - even if the limit value of 0.2 ohms is not exceeded. (Protective conductor or contacts).

The measurement must be performed according to DIN VDE 0751, Part 1 (see ARTD Part 2). The protective conductor resistance for all touchable conductive parts must be measured during the normal operating state of the system.

Make sure that control cables or data cables between the components of the system are not mistaken for protective conductor connections.

During the measurement, move the power cable and additional connection cables with an integrated protective conductor section by section to detect cable breaks.

The protective conductor resistance must not exceed 0.2 Ohms.

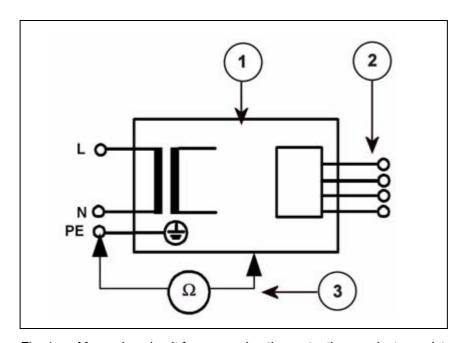


Fig. 1: Measuring circuit for measuring the protective conductor resistance for units that are disconnected from power, in compliance with DIN VDE 0751-1/2001-10, Fig. C2.

Pos. 1 = System

Pos. 2 = Application part type B (if available)

Pos. 3 = Measurement setup (integrated into measuring device)

The values determined must be recorded and assessed in the protective conductor resistance report and include the measured points.

The measuring procedure and the measuring device used (designation and serial number) must also be documented.

NOTE

The protective conductor resistance report is filed in "Certificates" register 9 in the system binder.

NOTE

A new report must be created if the protective conductor resistance measurements are not documented.

The Start-up Instructions SPR8-230.814.01.06 contain a new protective conductor resistance report. Separate this report from these instructions, fill it out, and file it in the "Certificates" register 9 in the system binder. If values are newly determined, they are to be recorded as first measured values. The evaluation is omitted in this case.

2.9 Information on measuring the leakage current

NOTE

During maintenance, the leakage current measurement must be conducted and recorded as a repeat measurement.

However, the first measured value must be newly determined and a new report be must created under the following conditions:

- Lack of documentation for leakage current measurement
- Deviation of the local line voltage from the line voltage documented in the report (e.g., location change/operator change)
- When a procedure for measuring the leakage current different from the one documented in the report is used.

For the purpose of traceability, reference to the new report must be written in the old report. The reason for newly determining the first measured value must be documented and confirmed with a name and signature.

Observe the instructions in the "Safety Rules for Installation and Repair" (ARTD-002.731.17 ...).

∆WARNING

Electrical voltage!

Non-compliance can lead to severe injury and even death.

□ The leakage current measurement may be performed on systems of protection class I only after the protective conductor test has been passed.

First measured value

The first measured value has already been determined and documented in the leakage current report. The measuring procedure was also recorded.

The measurement was performed with the recorded line voltage and with the recorded measuring equipment.

Measurement

Perform the measurement according to DIN VDE 0751, Part 1 (see ARTD-002.731.17...), and record the determined value.

The measuring procedure indicated in the report must be used.

If the first measured value has to be newly determined (see previous information), a measuring procedure can be selected (direct measurement or differential measurement).

Measurement of the leakage current according to the differential current method (measurement setup according to (Fig. 2 / p. 27)) must be given preference, since this method is not dangerous to the person performing the measurement and other persons.

However, please note the minimum resolution of the leakage current measuring device and any additional manufacturer information restricting the use of the measuring device.

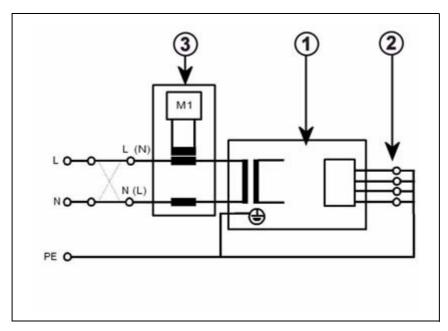


Fig. 2: Measuring circuit for measuring the system leakage current according to the differential current method in compliance with DIN VDE 0751-1/2001-10, Fig. C6 for protection class I.

Pos. 1 = System

Pos. 2 = Application part type B (if available)

Pos. 3 = Measurement setup (integrated into measuring device)

If the direct measurement of the leakage current is used (measurement setup according to (Fig. 3 / p. 28)), the system must be insulated during the measurement and must not be touched.

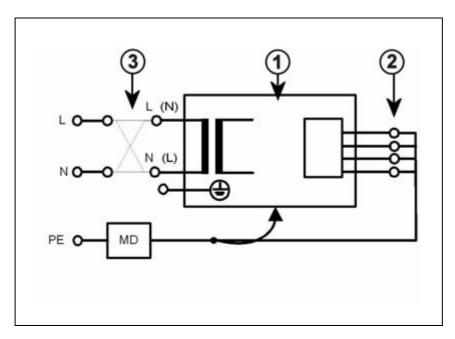


Fig. 3: Measuring circuit for direct measurement of the system leakage current in compliance with DIN VDE 0751-1/2001-10, Fig. C5 for protection class I.

Pos. 1 = System

Pos. 2 = Application part type B (if available)

Pos. 3 = Measurement setup (integrated into measuring device)

∆WARNING

Electrical voltage!

Non-compliance can lead to severe injury and even death.

- No housing parts of the system may be touched during direct measurement of the leakage current (measurement setup according to (Fig. 3 / p. 28)).
- □ Third-person access to the system must be prevented.

The system must be switched on during measurement. Measuring devices with automated measuring sequences must therefore be set to manual measurement.

The highest value is to be entered in the leakage current report.

This value must not exceed the permissible leakage current values according to DIN VDE 0751-1/2001-10, Table F.1, line "leakage current for devices according to remarks 1 and 3", of 2.5 mA.

Measure and record the current line voltage. If the measured line voltage deviates from the nominal voltage, correct the measured value to the value corresponding to a measurement at the nominal value of the line voltage. This must also be documented.

Document the measuring procedure (differential measurement or direct measurement) and the measuring device used (designation and serial number).

In the case of repeat measurements, the measured value must also be evaluated.

NOTE

For evaluation purposes, the first measured value and the values documented during maintenance or safety checks must be compared to the measured values. A sudden or unexpected increase in the measured values may indicate that a fault has occurred in the primary power supply circuit (insulation damage, damage from moisture, defective interference suppressor, etc.) - even if the limit value of 2.5 mA is not exceeded.

The evaluation is not necessary in the case of a new determination.

NOTE

The leakage current report is filed in the "Certificates" register 9 in the system binder.

NOTE

A new report must be created if the leakage current measurements are not documented.

The Start-up Instructions SPR8-230.814.01.06 contain a new leakage current report. Separate this report from these instructions, fill it out, and file it in the "Certificates" register 9 in the system binder. If values are newly determined, they are to be recorded as first measured values. The evaluation is omitted in this case.

2.10 Technical Safety Checks (TSC)

Abbreviation: TSC = Technical Safety Checks

NOTE

Within the purview of DIN VDE 0751-1, the operator of medical engineering products has to perform technical safety checks in regular intervals.

The checks listed in these maintenance instructions include all technical safety checks required by DIN VDE 0751-1.

A separate protocol with the print number SP00.000.834.01... is available for each technical safety check.

Within the purview of DIN VDE 0751-1, we recommend documenting the results of the maintenance both in the maintenance protocol and in the TSC protocol. The protocols should be filled out completely and handed over to the client after maintenance is complete.

In the table below each technical safety check listed in the document SP00.000.834.01... is assigned to the corresponding maintenance work.

Technical safety checks, test certificate of the check	Maintenance instructions for the check/comments
1 Identification data	Please fill in the fields.
2 General checks	n.a.
·	3.1.1 Damage, checks:
age affecting safety?	SIM Covers
	SIM Cassette holder
	SIM Control and display panel
	SIM Release cable
	SIM Single tank
	SIM Collimator
2.2 Are all cables and cable guides	3.2.9 Power cable, checks:
secure and without any visible damage?	SIM Check for mechanical defects
	SIM General cable winch information
	3.2.10 Power plug, check:
	SIM Check for mechanical defects
	3.2.15 Cable harness for arm system, check:
	SIM Damage-free

Technical safety checks, test certificate of the check	Maintenance instructions for the check/comments
2.3 Are undamaged accessories being used?	3.1.1 Damage, check:
	SIM DAP (optional)
	SIM Remote control (optional)
2.4 Unit radiation protection devices present and undamaged? (No on-site radiation shield)	3.3.4 Check of the radiation indicator, checks:
	SIE Radiation indicator
	SIE Ready indicator
	SIE Acoustic signal
	3.3.5 Manual termination of exposure, checks:
	SIE "ERR 39" display
	SIE Acoustic signals
2.5 Are the required operator documents	3.1 Visual inspection, check:
complete, present and legible?	SI Customer documentation
	Ask the customer for additional required operator documents and check them for completeness, availability, and legibility.
2.6 Are all warning labels in place and recognizable?	3.1 Visual inspection, check:
	SIM Signs
2.7 Are the operating symbols, light indi-	3.3.3 Control panel displays, checks:
cators and button labels OK?	SIE kV/mAs 7-segment displays
	SIE kV/mAs displays according to operating instructions
3. Electrical checks	n.a.
3.1 Measurement of ground wire resis-	3.9 Protective conductor test, check:
tance	SIE Protective conductor test
3.2 Measurement of device leakage current or equivalent device leakage current	n.a.
3.2.1 Device leakage current measure-	3.10 Leakage current measurement; check:
ment	SIE Leakage current measurement
3.2.2 Equivalent device leakage current measurement	n.a.
3.3 Measurement of patient device leakage current or equivalent patient device leakage current	n.a.

Technical safety checks, test certificate of the check	Maintenance instructions for the check/comments
3.3.1 Patient device leakage current measurement	n.a.
3.3.2 Equivalent patient device leakage current measurement	n.a.
4. Mechanical checks	n.a.
4.1 Are all wall, ceiling and floor mountings secure and undamaged?	n.a.
4.2 Are all mechanically moved system parts clean and running smoothly (lubricated, if required)?	3.2.5 Support arm transport lock, checks: SIM Check for mechanical defects SIM Locking mechanism 3.2.8 Arm system and single tank, checks: SIM Movement of the arm system SIM Movement of the single tank holder SIM Movement of the single tank
4.3 Cables, chains, belts, and spindles without signs of wear?	3.2.1 Back wheels, check: SIM Drive belt (Hybrid only)
4.4 Mobile equipment: Are the wheels, castors and brakes OK?	3.2.1 Back wheels, checks: SIM Check for mechanical defects SIM Brake pad SIM Secure attachment SIM Smooth rotation 3.2.2 Castors, checks: SIM Secure attachment SIM Smooth rotation 3.2.3 Front transport wheels, checks: SIM Secure attachment SIM Smooth rotation 3.2.4 Braking, checks: SIM Uniformity SIM Braking force
4.5 Is there any unusual noise during operation (e.g. gearing)?	3.2.8 Arm system and single tank, checks: SIM Movement of the arm system
5. Functional checks	n.a.
5.1 Function of the emergency-stop switch	n.a.

Technical safety checks, test certificate of the check	Maintenance instructions for the check/comments
5.2 Are the warning devices functioning properly?	3.3.4 Check of the radiation indicator, checks:
	SIE Radiation indicator
	SIE Ready indicator
	SIE Acoustic signal
5.3. Do all system movements stop properly in their end positions?	n.a.
5.4 Does the collision protection device stop all system movements properly (e.g. collision protection)?	n.a.
5.5. Are all safety distances (wall, floor, ceiling) met or ensured by other appropriate measures (such as light barriers)?	n.a.
5.6. Are the other safety shutdown devices functioning properly (e.g. safety floor plate)?	n.a.
5.7 Are the positions of table and unit reproducible (e.g. zero positions, layer height, etc.)?	n.a.

Technical safety checks, test certificate of the check	Maintenance instructions for the check/comments
6. Product-specific checks	3.2.6 Handles, check:
	SIM Attachment
	3.2.7 Collimator adjustment knobs, check:
	SIM Attachment
	3.2.11 Arm system attachment, check:
	SIM Screws and lock nuts
	3.2.12 Arm connector, check:
	SIM Screws and nuts
	3.2.13 Adjusting screw and cantilever, checks:
	SIM Lock nuts
	SIM Attachment of the base
	3.2.14 Single tank holder, checks:
	SIM Holder screw connections
	SIM Single tank screw connections
	3.6.1 DAP measuring system (optional), check:
	SIE Function of the DAP measuring system
	3.6.2 Remote control (optional), check:
	SIE Function of the remote control
7. Test result/evaluation:	Evaluate the long-term trends of the ground wire resistance and the device leakage current by comparing the current measuring values to those of the preceding technical safety checks. A sudden or unexpected increase in the measured values may indicate a safety-related defect - even if the limit values are not exceeded.
	Enter the check result.
	Have the operator, or a person authorized by the operator, sign the TSC protocol.
	Hand the TSC protocol over to the operator, or a person authorized by the operator.

3 Inspection and maintenance

3.1 Visual inspection

SIM Signs

- Check all signs on the system with the model and serial numbers as well as warnings.
 The placement of these signs is described in the operating instructions ("Signs" chapter).
- Verify that all signs are present and legible.

SI Customer Documentation

- The customer must be able to provide the following documents. The documents are to be checked for availability, completeness, and legibility.
 - Operating instructions
 - Start-up protocol
 - Last maintenance protocol

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- Maintenance records
- Service reports for repairs and adjustments
- DHHS documentation

3.1.1 Damage

- Check the unit for external damage (cracks, breaks, scratches, corrosion etc.).
- Check whether the single tank or the multileaf collimator show any signs of mechanical defects that can impair the radiation protection.
- Repair or replace affected parts.

SIM Covers

SIM Cassette holder

SIM Control panel and display panel

SIM Release cable

SIM Single tank

SIM Collimator

SIM DAP (optional)

- The DAP ionization chamber should not have any scratches.
- No damage to DAP supply line, plug or display

SIM Remote control (optional)

No damage to remote control

3.2 Mechanical inspection

∆WARNING

There is danger of life-threatening electrical shock. It is possible to come into contact with live parts when the covers are removed.

If safety measures are not observed, death or serious bodily injury can occur.

□ Take general and product-specific precautions before opening.

3.2.1 Back wheels

SIM Check for mechanical defects

NOTE

First perform the work steps described in the "Back wheels" section on one wheel. Then check the other wheel.

- Check the back wheels for damage.
- Elevate one side of the system by placing a piece of wood under the chassis (Fig. 1 / p. 36).
- Secure the wheel on the other side with 2 blocks.
- Remove the wheel cap and wheel (Fig. 1 / p. 36).

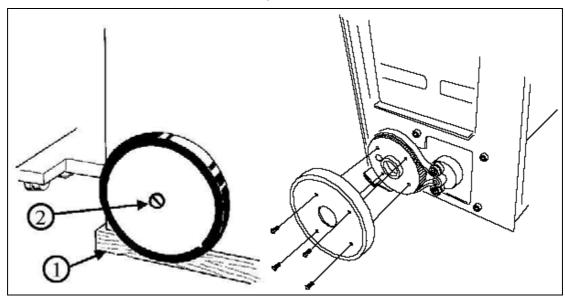


Fig. 1: Braked wheels

SIM Brake pad

Check the brake pad.(Fig. 2 / p. 37) The brake pad must be > 1mm. If worn (pad < 1mm), replace the brake according to the instructions in "Replacement of Parts".

SIM Secure attachment

Securely reattach the wheel.

SIM Smooth rotation

Check that the wheel rotates freely.

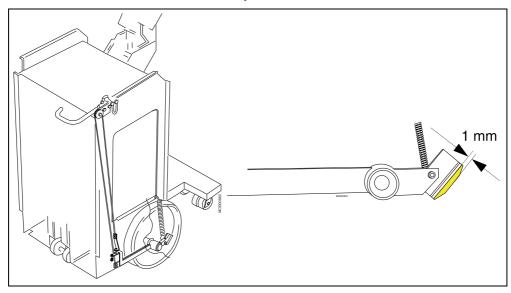


Fig. 2: Smooth rotation

SIM Drive belt (Hybrid only)

 Check the condition/tension of the drive belt (Fig. 1 / p. 36) (Adjustment procedure is described in the "Replacement of parts" instructions).

NOTE

Under normal operating conditions, the drive belt does not need to be readjusted during the life of the system.

NOTE

After checking the wheels, leave the system elevated and check the castors.

3.2.2 Castors

- Lock the back transport wheels with the parking brake.
- Elevate one side of the system.

SIM Secure attachment

Check the attachment.

SIM Smooth rotation

Check that the castors rotate freely.

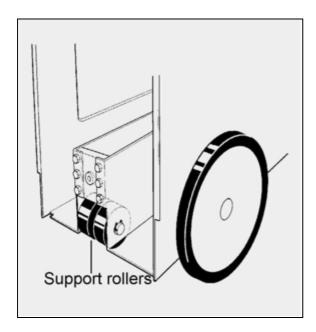


Fig. 3: Rollers

.

3.2.3 Front transport wheels

- Lock the back transport wheels with the parking brake.
- Elevate the front transport wheels with a piece of wood (Fig. 4 / p. 38).

SIM Secure attachment

Check the attachment.

SIM Smooth rotation

• Check that the wheels rotate freely.

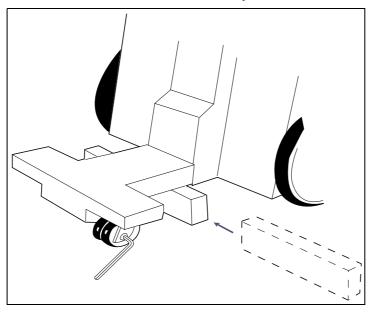


Fig. 4: Raise the front of the system

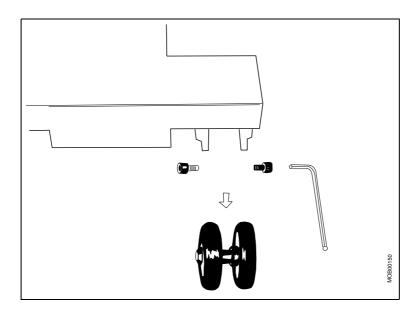


Fig. 5: Installing the front transport wheels

3.2.4 Braking

SIM Uniformity

- The brake pad should not rub during transport.
- Brake the system during transport. The system should not pull to one side during braking.

SIM Braking force

- Activate the brake.
- Use the spring balance to pull the system forward and back.
- The system should not move under 350N (adjusting the brakes is described in the "Replacement of parts" instructions)

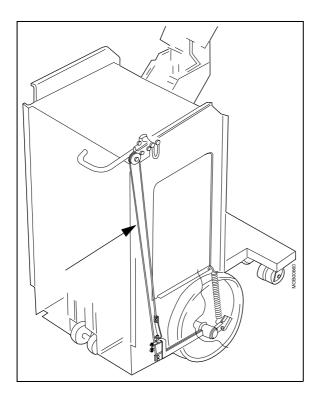


Fig. 6: Hand brake

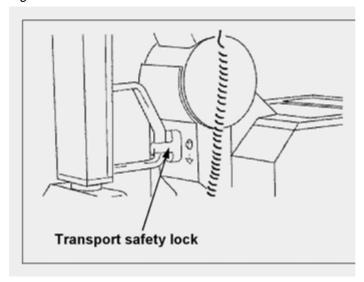


Fig. 7: Support arm and transport safety lock handle



Fig. 8: Collimator handle

3.2.5 Support arm transport lock

SIM Check for mechanical defects

• Check the transport lock for mechanical defects. Replace lock, if damaged.

SIM Locking mechanism

• Verify that the support arm handle engages securely in the transport lock.

3.2.6 Handles

SIM Attachment

 Verify that the support arm and collimator handles are securely attached. Tighten the screws, if necessary.

3.2.7 Collimator adjustment knobs

SIM Attachment

• Verify that the collimator adjustment knobs are properly seated.

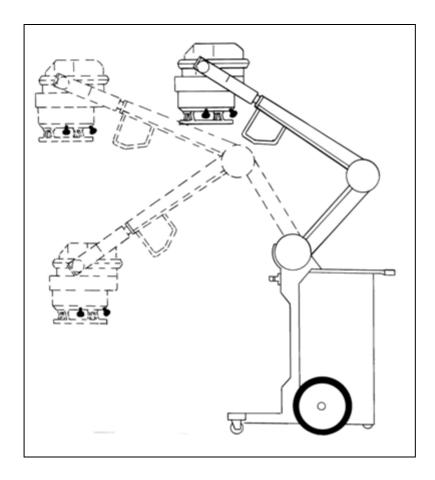


Fig. 9: Arm system

3.2.8 Arm system and single tank

SIM Movement of the arm system

• Move the support arm into all the usual positions. The arm should not move up or down after you release it. (To adjust the friction brakes, refer to the "Replacement of parts" instructions).

SIM Moving the single tank holder

The single tank holder must be easy to turn and maintain in any position.

SIM Moving the single tank

The single tank must be easy to turn and maintain in any position.

3.2.9 Power cable

NOTE

Replacing the cable winch, including the cable:

MOBILETT XP (Eco) every 2 years **MOBILETT XP Hybrid every 4 years**

PMP Cable winch replacement

CS PS 24

• If the replacement interval has been reached, replace the cable winch according to the "Replacement of parts" instructions.

SIM Check for mechanical defects

Pull the entire mains cable (6m) out of the cable winch. Check the cable for visible damage.

SIM General cable winch information

- Pull the entire mains cable (6m) out of the cable winch. Hold the cable while coiling and move it up and down until the cable is fully coiled. Verify that the cable winch and the brake work properly.
- If necessary, replace it according to "Replacement of parts".

PMP Cleaning

 Clean the mains cable with a cloth. Dampen the cloth with a mixture of lukewarm water and household cleaner.

3.2.10 Power plug

SIM Check for mechanical defects

- Verify that the plug works properly during plugging and unplugging.
- Open the plug and check the terminals and strain relief. The ground wire has to be slightly longer than the other wires (applies to all plug types).

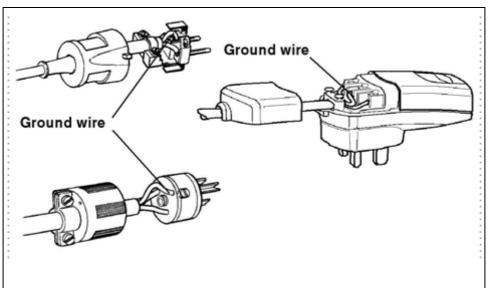


Fig. 10: Ground wire

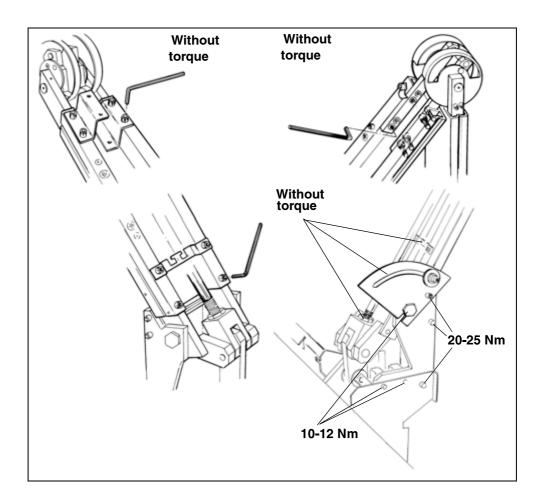


Fig. 11: Arm system attachment

3.2.11 Arm system attachment

Remove the top and bottom arm covers from the column.

SIM Screws and lock nuts

Check that the screws and lock nuts are seated securely (Fig. 11 / p. 44).

3.2.12 Arm connector

• Remove the covers from the bottom arm articulation.

NOTE

For easier reassembly, note the disassembly sequence.

• Check that the screws and nuts are seated securely.

SIM Screws and nuts

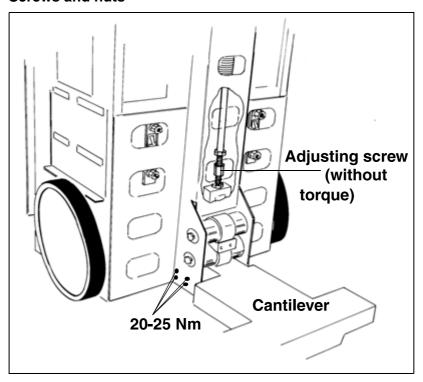


Fig. 12: Adjusting screw and cantilever attachment

3.2.13 Adjusting screw and cantilever



Uncontrolled system movements pose danger of injury. The supporting arm can fall if improperly maintained!

Death or serious bodily injury can occur.

□ Do not loosen the nuts on the adjusting screw and do not turn the adjusting screw.

SIM Lock nuts

Verify that the lock nuts on the adjustment knobs are properly seated.

SIM Attachment of the base

• Verify that the base attachment in the chassis is secure.

3.2.14 Single tank holder

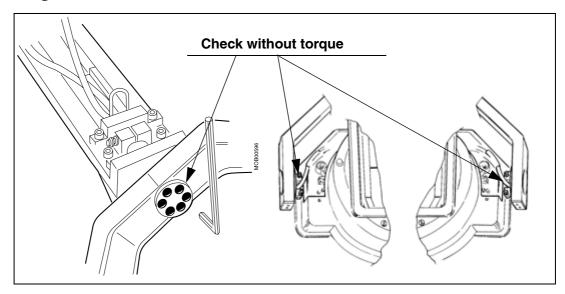


Fig. 13: Holder and single tank attachment

SIM Holder screw connections

• Verify that the screw connections on the support arm holder are secure.

SIM Single-tank screw connections

Verify that the four screws on the single tank are secure.
 Completely remove any loose screw connections and screw them in again using LOCTITE 242.

3.2.15 Cable harness for the arm system

SIM Damage-free

- Check all support arm cabling for damage (stretching, twisting, insulation cracks). Pay special attention to the stress points of moving elements (Fig. 14 / p. 47).
- Replace any damaged cables.

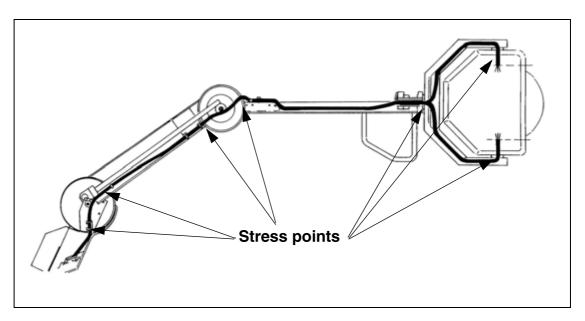


Fig. 14: Cable stress points

3.2.16 Lubrication

Remove the cover of the column stand.

PMP Pull-bar slide bushing

Lubricate the pull bar of the side bushing (Fig. 15 / p. 47).

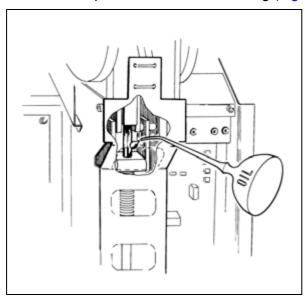


Fig. 15: Lubrication point

3.3 Function inspection

3.3.1 Service mode

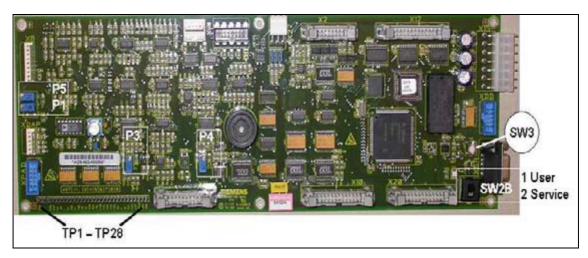


Fig. 16: CPU D916

Activating service programs

- Switch off the system and remove the top cover.
- Move service switch SW2B into back position 2 on board D916.
- Switch the system on.
 - □ "Pr 1" is displayed on the control panel.
- Use the mAs+/mAs- buttons to select the desired service program.

NOTE

The X-ray function is deactivated during an active service program.

For detailed information, refer to the troubleshooting instructions in SPR8-230.840.01...

3.3.2 Operating information

Select ServiceProgram 02 and record the counter status in the protocol.

PMF Exposure counter

Select and read out ServiceProgram 03 If a defective component message displays, check it according to the troubleshooting instructions. Then reset the memory.

PMF Error log

NOTE

Use other service programs only if the user requests changes. For detailed information, refer to the troubleshooting instructions in SPR8-230.840.01... The value initially set should be taken from the start-up protocol.

3.3.3 Displaying the control panel

- The yellow LED mains control must be lit when the mains plug is plugged in (3/Fig. 17 / p. 49).
- System ON.
- The kV/mAs default values must display and be completely legible (take the default values from the start-up protocol).
- The green ready LED (2/Fig. 17 / p. 49) should light up within 15 seconds of "system ON".
- Select all kV/mAs values. The system and type of operation determine the mix/min values (see technical data in the operational instructions). Restrictions are possible in accordance with the start-up protocol.

PMF Mains display

PMF kV/mAs default values

SIE kV/mAs segment displays

PMF Ready indicator

SIE kV/mAs displays according to operating instructions

3.3.4 Checking the radiation indicator



Fig. 17: Control panel displays



- Set 81 kV and 10 mAs.
- Release an exposure.

The radiation indicator (1/Fig. 17 / p. 49) lights up during the exposure; at the same time an acoustic signal sounds and the "ready" light goes out.(2/Fig. 17 / p. 49).

• The "ready" light (2/Fig. 17 / p. 49)goes on again within a maximum of 15 seconds.

SIE Radiation ON indicator

SIE Ready indicator

SIE Acoustic signal

3.3.5 Manual termination of exposure

The user must be able to cancel an exposure at any time.



- Set an average kV value (e.g., 70 kV) and the highest possible mAs value.
- Release an exposure and interrupt it immediately. The display then reads "ERR 39" and several short acoustic signals are emitted ("ERR 39 = exposure aborted). Acknowledge the error message with the "collimator light" key on the control panel.

SIE "ERR 39" display

SIE Acoustic signals

3.4 Collimator

3.4.1 Replacing the lamp



• The collimator lamp must be replaced every year.

NOTE

If necessary, the customer's technical personnel may replace the lamp outside the maintenance period.

Tools and auxiliary materials required

- Rope for securing the support arm (approx. 4m long)
- Allen wrench set
- Screw driver set 1-6 (Phillips head and slotted head screws)

24V/100W lamp - Siemens order no.: 08392016

NOTE

Do not touch the lamp with bare hands. Touch the bulb only with a clean, dry cloth.

Required work steps:

- Turn the system OFF and disconnect the mains plug (Hybrid mode selector switch = 0).
- Remove the DAP ionization chamber.
- Move the system into the position illustrated in (B/Fig. 18 / p. 52) (table edge).
- Secure this position, ensuring that the single tank is resting on the table (A/Fig 18).
- Loosen and remove the two rotary knobs of the collimator (2mm Allen wrench (C/Fig. 19 / p. 52)).
- Loosen the collimator cover (Phillips head screwdriver (1/Fig. 20 / p. 53)).
- Carefully turn the cover and loosen the 4 connectors ((Fig. 21 / p. 53)/gnd = grounding contact; DAP terminal; lsw = light switch).
- Remove the protective cover on the lamp (4/Fig. 22 / p. 53).
- Note the position of the lamp filament (6/Fig. 23 / p. 54). The filament of the new lamp must be in the same position as the one being removed.
- Remove the old lamp from the socket (5/Fig. 23 / p. 54) and insert the new one. Only use a cloth to touch the new lamp; pay attention to the filament position.
- Perform all work steps in reverse.

PMP Annual replacement of the collimator lamp

Turn the system ON and test the function of the light at all 3 light localizer buttons.

PMF Light localizer function

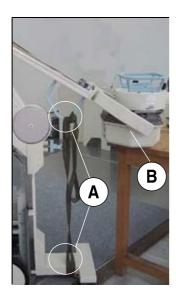


Fig. 18: Single-tank service position

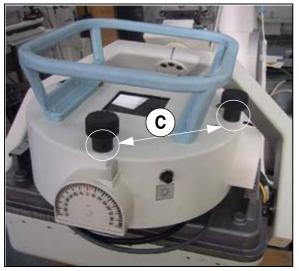


Fig. 19: Collimator rotary knobs

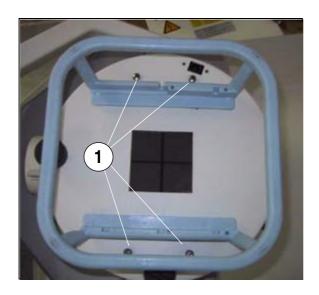


Fig. 20: Collimator cover

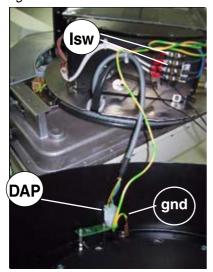


Fig. 21: Terminals in the cover

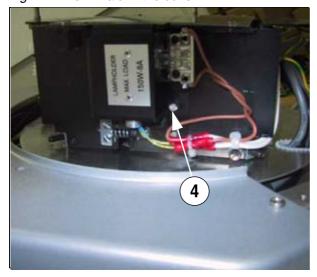


Fig. 22: Lamp socket

S

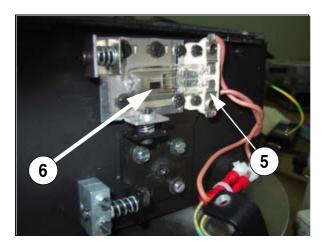


Fig. 23: Collimator lamp

3.4.2 Check of illuminance

U Required measuring instrument:

- Lux meter

If the light localizer is switched on for illuminating the radiation field, the average illuminance must be at least 180 Lux at a distance of 100 cm. The average illuminance is determined in that measurements are performed approximately in the center of each of the four light field quadrants (Fig. 24 / p. 54). Log the illuminance.

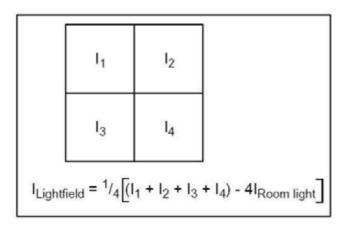


Fig. 24: Illuminance

PMF illuminance

3.4.3 Light field/radiation field

- Prepare a 35x35cm cassette with film.
- Place the cassette on a suitable base.
- Set SID to 100 cm (use tape measure of the collimator).

- Align the light localizer to the cassette and collimate to 25 x 25 cm.
- Mark the four sides and one of the corners (e.g. with coins / (Fig. 25 / p. 55)).



- Set the control panel to 55 kV/2.5 mAs and release an exposure.
- Develop the film.
- Measure the deviation between the light field and the radiation field ((Fig. 26 / p. 55)).

The allowable deviation is \pm 1.7% of the SID (Fig. 26 / p. 55) (SID = source image distance). If the deviation is > 1.7%, the collimator must be adjusted (see the "Replacement of Parts" instructions). Log the deviation.

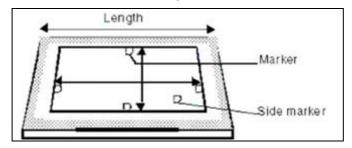


Fig. 25: Light field/radiation field, cassette

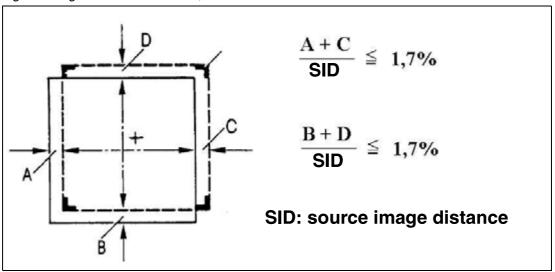


Fig. 26: Light field/radiation film

QSQ Deviation ((A + C) / SID)

QSQ Deviation ((B + D) / SID)

3.5 Inspection of XP Hybrid only

3.5.1 Batteries

NOTE

The expected life of the battery packs BK1-BK4 is estimated at 12 - 24 months. The is no acceptable measuring procedure to determine the battery quality. The user must provide the charge/discharge time ratio.

During normal operation, the longest charge time is approx. 12 hours. Three yellow LEDs light on the control panel (1/Fig. 27 / p. 56).

One discharge cycle allows for 80 exposures with maximum kV/mAs values and transport operation of approx. 3,000 m.

Realistic statement: The MOBILETT does not need to be charged during the 12-hour workday.

If the lowest battery charge is reached in < 5 hours, the battery must be replaced.

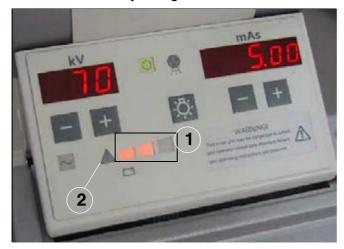


Fig. 27: State display

PMF Charging performance

Ask operating personnel about the required charging cycles.

If necessary, replace the batteries as described in "Replacement of parts".

NOTE

Completely reassemble the system and attach all the covers for the following work procedures.

3.5.2 Motor drive

- Turn the system ON and release the hand brake.
- Check the transport movements according the operating instructions.

PMF Forward/backward

PMF Slow/fast

3.6 Options

3.6.1 DAP measuring system

• Press the Test button on the DAP display.

The displayed value must be in the range of 80-120 μ Gym² (DAP resolution 0.1 μ Gym²) or in the range of 8-12 μ Gym² (if using a high resolution chamber, i.e. DAP resolution 0.01 μ Gym²).

Otherwise, the DAP measuring system has to be calibrated according to the "Replacement of Parts" instructions.



Verify the function of the DAP measuring system by releasing an exposure.

The display has to show a measurement value.

SIE Function of the DAP measuring system

3.6.2 Remote control

Replace the battery (9V alkaline)

PMP Battery replacement for remote control (yearly)

- Check the function of the remote control.
- Switch on the light localizer of the collimator.



• Release an exposure.

SIE Remote control function

3.7 Checking the kV/mAs exposure parameters

3.7.1 kV accuracy

Requirement:

The measured kV values must comply with the limit values specified in the tables. One of two measuring methods can be used:

- 1.) kV meter method:
 - kV meter based on the filter comparison method (e.g. PTW Nomex)
 Use the correction factor given in the kV meter operating instructions for non-invasive kV measurements.

2.) Oscilloscope method:

- Storage oscilloscope with a measuring accuracy of ± 2.5%

kV meter procedure:

NOTE

The inherent filtration (AL equivalent) of MOBILETT XP (Eco) and Hybrid is 3.1mm Al (single tank plus collimator).

An installed DAP measurement chamber increases the inherent filtration by 0.4 mm Al.

- Prepare the kV meter for the measurement according to the operating instructions.
- Place the measuring detector on a suitable surface and adjust the single tank to the detector with the light localizer (Fig. 28 / p. 60).
- Set the source-image distance to the value specified in the kV meter operating instructions.

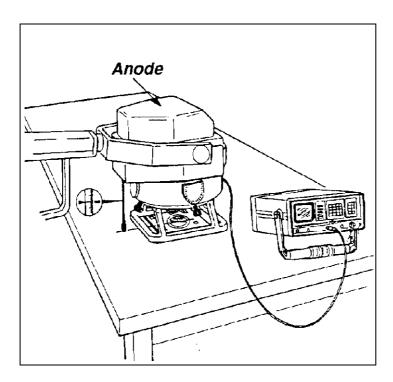


Fig. 28: kV measurement

For the MOBILETT XP (Eco):

• Connect the power plug and turn the unit power switch "ON".

For the MOBILETT XP Hybrid:



- Disconnect the power plug; first switch the unit to the battery mode and then "ON".
- Set the following exposure parameters and release an exposure after each setting:

kV meter Selection	Exposure parameters		Limit values*
	52 kV	50 mAs	49.0 - 55.0 kV
DC voltage	81 kV	20 mAs	77.0 - 85.0 kV
	MOBILETT XP (Hybrid)		MOBILETT XP (Hybrid)
	133 kV	12.5 mAs	126.4 - 139.6 kV
	MOBILETT XP Eco		MOBILETT XP Eco
	125 kV	12.5 mAs	118.8 - 131.2 kV

^{*} The measuring inaccuracy of the measuring instrument used must be deducted from the specified limit values.

Record the measured values.

PMF kV accuracy 52 kV, 50 mAs PMF kV accuracy 81 kV, 20 mAs PMF kV accuracy 133 kV, 12.5 mAs PMF kV accuracy 125 kV, 12.5 mAs

Additional test for the MOBILETT XP Hybrid



- Connect the power plug and switch the unit "ON" in the "line-powered" mode.
- Set the following parameters and release an exposure:

kV meter Selection	Exposure parameters		Limit values*
DC voltage	81 kV	20 mAs	77.0 - 85.0 kV

Record the measured value.

PMF kV accuracy 81 kV, 20 mAs

Oscilloscope method:

"KVS" measuring point for the nominal value and "KV" measuring point for the actual value.

The measuring ratio is 30 kV/V.

- Open upper unit cover; measuring points on CPU D916 (see troubleshooting instructions).
- Follow the same procedure as described in the "kV meter method" section.

3.7.2 mAs accuracy

Requirement:

The measured mAs values must comply with the limit values specified in the tables. One of two measuring methods can be used:

- 1.) mAs meter method:
 - mAs meter (e.g., MAS meter 8160400 with a measuring accuracy of 1 $\% \pm 1$ decimal place)
- 2.) Oscilloscope method:
 - Storage oscilloscope with a measuring accuracy of ± 2.5%

Oscilloscope method:

- Close the multileaf collimator and open the upper unit cover.
- Clamp the oscilloscope to the "JR" and "GND" measuring points on CPU D916.

For the MOBILETT XP (Eco):

• Connect the power plug and turn the unit power switch "ON".

For the MOBILETT XP Hybrid:

Pull the power plug and switch the unit to the battery mode first and then "ON".

After switching the unit on (switch setting: "ON"), wait for approx. 5 minutes to let it stabilize.

Example: Calculation of the mAs value

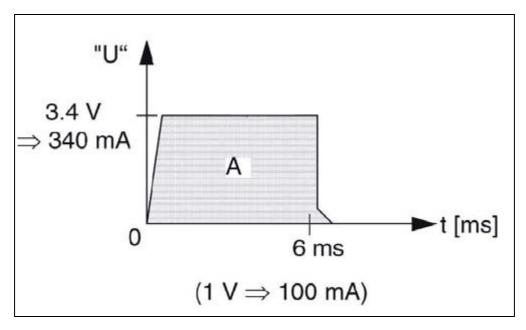


Fig. 29: mAs calculation

The mAs value can be calculated with the help of the oscilloscope display.

Surface "A" corresponds to the mAs value.

mAs = Tube current x Exposure time

mAs = 340 mA x = 0.006 s = 2.0 mAs

Determination for the following exposure parameters (product of tube current x exposure time):



Control unit setting		Permissible mAs value*
kV	mAs	
40	5	4,7 - 5,3
81	2	1,9 - 2,1
MOBILETT XP (Hybrid) 133 MOBILETT XP Eco 125	10	9,5 - 10,5

^{*} The measuring inaccuracy of the measuring instrument must be deducted from the specified limit values.



Calculate and record the mAs values.

PMF kV accuracy 40 kV, 5 mAs

PMF kV accuracy 81 kV, 2 mAs

PMF kV accuracy 133 kV, 10 mAs

PMF kV accuracy 125 kV, 10 mAs

Additional test for the MOBILETT XP Hybrid

- Connect the power plug and switch the unit "ON" in the "line-powered" mode.
- Set the following parameters and release an exposure:

Set the control unit to:		Permissible mAs value*
kV	mAs	
81	2	1,9 - 2,1

Calculate and record the mAs value.

PMF kV accuracy 81 kV, 2 mAs

mAs meter method:

Use of the mAs jumper on PCB D907 directly on the single tank.

- Remove cover from single tank and connect mAs meter to D907 (1/Fig. 30 / p. 63).
- Follow the same procedure as described in "Oscilloscope method".
 For more information on the measuring technique, refer to the user's manual for the mAs meter.

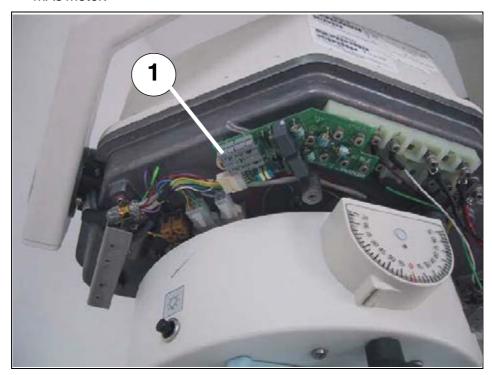


Fig. 30: mAs jumper D907

3.8 Reproducibility test (USA only)

U S

Requirement:

The coefficient of variation for the radiation dose for any combination of exposure parameters does not exceed 0.045. This requires operation at the line voltage compliant with Siemens specifications.

NOTE

In the following test, 10 sequential exposures are taken within one hour.

The exposure parameters should be briefly set to different values following each measurement.

Required measuring instrument:

- Dosimeter

Procedure:



After switching the system on, wait until its temperature has stabilized. The unit is ready for these measurements after 15 minutes.

- Release the number of exposures with the specified exposure data:
 - 85 kV, 1.0 mAs, 10 exposures.
- Measure the dose for each exposure.
- Reset the display prior to each new measurement.

Calculations: Coefficient of variation C

Coefficient of variation C is determined for a series of 10 dose measurements with the following formula:

$$c = \frac{s}{\overline{x}} = \frac{1}{\overline{x}} \left[\sum_{i=1}^{n} \frac{(x_i - \overline{x})^2}{n - 1} \right]^{\frac{1}{2}}$$

Fig. 31:

Standard deviation resulting from the measurements

Average measurement of series Χ

i. measurement of series X_i

Number of individual measurements in series

The following shows an example of the procedure. Follow this procedure and record the result in the protocol.

Coefficient of variation C must be ≤ 0.045 .

QSQ Coefficient of variation C

If the value obtained is > 0.045, locate and correct the cause according to the trouble-shooting instructions (see troubleshooting instructions).

Example for determining coefficient of variation C:

Step 1)

• 10 exposures with recorded measurements (fictitious measured values).

Exposure (n=10)	Measurement values
(1.13)	(xi)
1	1,01
2	1,02
3	1,03
4	1,04
5	1,03
6	1,02
7	1,02
8	1,01
9	1,03
10	1,04

Step 2)

Addition of measured values:

$$\Sigma = 1.01 + 1.02 + 1.03 + 1.04 + 1.03 + 1.02 + 1.02 + 1.01 + 1.03 + 1.04 = 10.25$$

$$\bar{x} = \frac{\Sigma}{n} = \frac{10.25}{10} = \bar{x} = 1.025$$

Fig. 32:

Step 3)

Calculation of standard deviation:

$$s = \sqrt{\frac{(x_i \cdot \bar{x})^2}{n \cdot 1} + \dots} =$$

Fig. 33:

$$\sqrt{\frac{(1.01-1.025)^2}{9} + \frac{(1.02-1.025)^2}{9} + \frac{(1.03-1.025)^2}{9} + \frac{(1.04-1.025)^2}{9} + \frac{(1.04-1.025)^2}{9} + \frac{(1.02-1.025)^2}{9} + \frac{(1.02-1.025)^2}{9} + \frac{(1.01-1.025)^2}{9} + \frac{(1.03-1.025)^2}{9} + \frac{(1.04-1.025)^2}{9} = S}$$

Fig. 34:

$$\sqrt{2.5 \times 10^5 + 2.8 \times 10^6 + 2.8 \times 10^6 + 2.5 \times 10^5 + 2.8 \times 10^6 + 2$$

$$2.8 \times 10^6 + 2.5 \times 10^5 + 2.8 \times 10^6 + 2.5 \times 10^5 => s = 0.0108$$

Fig. 35:

Step 4)

• Calculation of coefficient:

$$C = \frac{s}{x} = \frac{0.0108}{1.025} = 0.0105$$

Fig. 36:

In this example, the generator complies with the specification:

C = 0.0105, hence it is ≤ 0.0450 .

NOTE

Completely reassemble the system and attach all the covers for the following work procedures.

3.9 Protective conductor test

SIE Protective conductor test

Observe the protective conductor resistance test information in these instructions.

• The protective conductor test is to be performed on a closed system according to ARTD-002.731.17...

The protective conductor resistance must not exceed 0.2 Ohms.

- The values determined must be recorded and assessed in the protective conductor resistance report and include the measured points.
- The measuring procedure and the measuring device used (designation and serial number) must also be documented.

NOTE

The protective conductor resistance report is filed in "Certificates" register 9 in the system binder.

NOTE

A new report must be created if the protective conductor resistance measurements are not documented.

The Start-up Instructions SPR8-230.814.01.06 contain a new protective conductor resistance report. Separate this report from these instructions, fill it out, and file it in the "Certificates" register 9 in the system binder. If values are newly determined, they are to be recorded as first measured values. The evaluation is omitted in this case.

3.10 Leakage current measurement

SIE Leakage current measurement

Observe the leakage current measurement information in these instructions.

 The leakage current is to be measured when the system is closed according to ARTD-002.731.17...

The measuring procedure indicated in the report must be used. If the first measured value has to be newly determined, a measuring procedure can be selected (direct measurement or differential measurement).

The limit value of 2.5 mA may not be exceeded.

AWARNING

Electrical voltage!

Non-compliance can lead to severe injury and even death.

- No housing parts of the system may be touched during direct measurement of the leakage current .
- □ Third-person access to the system must be prevented.
- The system must be switched on during measurement. Measuring devices with automated measuring sequences must therefore be set to manual measurement.
- Document the measuring procedure (differential measurement or direct measurement) and the measuring device used (designation and serial number).
- Measure and record the current line voltage. If the measured line voltage deviates from the nominal voltage, correct the measured value to the value corresponding to a measurement at the nominal value of the line voltage. This must also be documented.
- The highest value is to be entered in the leakage current report and evaluated.

NOTE

The leakage current report is filed in the "Certificates" register 9 in the system binder.

NOTE

A new report must be created if the leakage current measurements are not documented.

The Start-up Instructions SPR8-230.814.01.06 contain a new leakage current report. Separate this report from these instructions, fill it out, and file it in the "Certificates" register 9 in the system binder. If values are newly determined, they are to be recorded as first measured values. The evaluation is omitted in this case.

3.11 Cleaning

• Dampen a cloth with a mixture of lukewarm water and regular household cleaner. Clean the entire system.

PMP Cleaning

4 Changes to previous version

Chapter	Section	Revision
General maintenance information	Information on the protective conductor resistance test	New section
General maintenance information	Information on measuring the leakage current	New section
Inspection and maintenance	Protective conductor test	Completely rewritten
Inspection and maintenance	Leakage current measure- ment	Completely rewritten